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ABSTRACT

This report presents the labor force characteristics of older doctoral scientists and engineers using data from the National Science Foundation's (NSF) Survey of Doctorate Recipients (SDR) from 1997. The information presented in the report includes employment, education, and demographic data on all graduate degrees considering the age factor. (YDS)

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Older Doctoral Scientists and Engineers: Selected Labor Force Characteristics

Special Report

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Division of Science Resources Statistics
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National Science Foundation

July 2002

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Special Report

Robert P. Morgan, Author
Kelly H. Kang, Program Officer

Division of Science Resources Statistics
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National Science Foundation

July 2002

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Older Doctoral Scientists and Engineers: Selected Labor Force Characteristics

With the aging of the U.S. population, older individuals are becoming an increasingly important factor in the health and vitality of the U.S. labor force including that portion in science and engineering occupations.[1] For example, Stephan and Levin (1992) pointed out that, in the early 1970s, almost half of all academic scientists were under the age of 40, compared to 28 percent some 20 years later.[2] By 1997, that figure had fallen to 25 percent for doctoral scientists and engineers in the education sector.[3] An analysis in *Science and Engineering Indicators: 2000* concluded that if current retirement patterns continue, the number of retirements among workers with science and engineering (S&E) degrees, especially those with doctoral degrees, will increase over the next 10-15 years. Even with these retirement patterns, the average age of this group will continue to rise unless there are large increases in degree production.[4]

Data from the National Science Foundation's Survey of Doctorate Recipients (SDR) can be used to analyze labor force characteristics of older doctoral scientists and engineers, which can aid in assessing future human resource requirements. The SDR data also facilitate comparison of these characteristics between younger scientists and engineers and those of their older colleagues. This report presents selected results, derived primarily from the 1997 SDR, which illuminate certain labor force characteristics of doctoral scientists and engineers for different age groups. Particular attention is paid to those aged 55 and older.

Initiated in 1973, the SDR is a longitudinal demographic survey of science and engineering doctorate holders conducted every two years for the National Science Foundation (NSF) and other Federal agencies. The SDR database contains information on various educational and work-related characteristics of scientists and engineers, which can be compared for different age groups. The sampling frame for the SDR is the Doctoral Records File (DRF), a census of all research doctorates earned in the U.S. since 1920. The 1997 SDR sample included 54,100 doctoral-level scientists and engineers who were recipients of doctoral degrees in a science or engineering field from a U.S. institution between January 1942 and June 1996, aged 75 or younger, and residing in the U.S. during the week of April 15, 1997. The estimated size of this population is 582,080.

The following results, unless noted, are derived from the 1997 SDR database. A limited number of comparisons are made with results from the 1993 and 1995 SDR's as well as with relevant 1997 data from NSF's Scientists and Engineers Statistical Data System (SESTAT) database. SESTAT is an integrated information system containing employment, education, and demographic data on both doctoral and non-doctoral (i.e., those whose highest degree was a bachelor's or master's degree) scientists and engineers in the United States.[5] In addition, differences in results among the three principal employ-

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[1]Two U.S. government publications provide a wealth of information about the older population. *Older Americans 2000: Key Indicators of Well-Being*, released by the Federal Interagency Forum on Aging Related Statistics, reports indicators of population, economics, health status, health risks and behaviors, and health care. In September 2000, the U.S. Census Bureau issued *The Older Population in the United States*, based on results of the March 1999 Current Population Survey. This latter report summarizes selected economic and social characteristics of the U.S. civilian, non-institutionalized population aged 55 and older.

[2]See P. Stephan and S. Levin, *Striking the Mother Lode in Science: The Importance of Age, Place and Time* (New York: Oxford University Press, 1992). Examining the relationship between age and ability to do scientific work, Stephan and Levin reached two main conclusions. First, scientists write less as they age, though this effect is not great for average (versus exceptionally productive) doctoral scientists. Second, there is a stronger relationship between age and exceptional contributions to science, with most such contributions being made before age 40 (pp. 156-7).

[3]Source: National Science Foundation/Division of Science Resources Statistics, 1997 Survey of Doctorate Recipients. See also note 6.

[4]Source: National Science Board, *Science and Engineering Indicators: 2000* (Arlington, VA: National Science Foundation, 2000 (NSB-00-1)), pp. 3-23.

[5]SESTAT contains data from three national sample surveys, including the SDR. For further information, see Nirmala Kannankutty and R. Keith Wilkinson, *SESTAT: A Tool for Studying Scientists and Engineers in the United States* (Arlington, VA: National Science Foundation, Division of Science Resources Statistics, NSF 99-337, 1999).

ment sectors for doctoral scientists and engineers—education, government, and industry—are highlighted.[6]

This report aims to shed light on the following questions about the characteristics of U.S. doctoral scientists and engineers:

1. What is the age distribution of scientists and engineers by labor force status and employment sector? Do these differ according to field of doctoral study?

2. How does labor force status such as not being employed and looking for work, or working part-time but wanting full-time vary with age?

3. How do factors that might be related to labor force status (including retirement) vary with age? Factors explored in the survey include buyout offers, employer-provided health benefits, and level of job satisfaction.

4. How does productivity vary with age? Factors examined include rates of publication and patent application activity.[7]

There appears to be no firm definition of what is meant by "older" scientists and engineers. Within the context of this report, "older" generally refers to those 55 years and up. However, where the data warrant, other age groupings are utilized, which may commence at an age greater than 55.

In this report, doctoral scientists and engineers are defined as individuals having doctoral degrees in one of five science and engineering fields: computer and mathematical sciences; life and related sciences; physical and related sciences, social and related sciences; and engineering.[8] The analysis does not focus on occupations.

Labor Force Status and Employment Sector: Relationship to Age

Persons holding science and engineering doctorates have a high rate of participation in the labor force. Of the estimated 582,080 persons under the age of 76 who had received a doctorate in science or engineering from an U.S. institution, there were 518,440 (89 percent) employed during the week of April 15, 1997. An additional 6,390 (1 percent) were unemployed; and 57,250 (10 percent) were not in the labor force.[9] For scientists and engineers with doctorates, those 55 or older constituted 31 percent of all scientists and engineers, about one-quarter (25 percent) of employed scientists and engineers, 32 percent of the unemployed, and 83 percent of those not in the labor force.

Between 1993 and 1997, the percentage of employed doctoral scientists and engineers who were 55 or older increased from 21 percent to 25 percent while the percentage of all doctoral scientists and engineers 55 or older rose from 26 percent to 31 percent.[10] These increases show that the age distribution of the doctoral science and engineering population over the mid-1990s was becoming increasingly skewed towards older scientists and engineers. At the other end of the age spectrum, the percentage of doctoral scientists and engineers aged 39 or less fell slightly, from 23 percent in 1993 to 22 percent in 1997.[11]

Table 1 shows the labor force status of doctoral scientists and engineers by age. For ages 54 and younger, the employment rate was about 96 percent. For older age groups, the employment rate was lower, due to doctoral scientists and engineers leaving the labor force. However, for doctoral scientists and engineers aged 65-69, about half (53 percent) were still working. At 70-75,

[6]In the three-sector employment summary utilized in analyzing SDR results, the education sector consists largely of universities and other institutions of higher education. The industry sector contains large and small businesses, as well as self-employed scientists and engineers.

[7]To date, information on patents and publications is only available in the 1995 SDR.

[8]For the limited number of comparisons with scientists and engineers whose highest degree was a bachelor's or a master's degree, as obtained from the SESTAT database, a sixth degree field category, non-science and engineering degree, was included in the degree totals for those two degree levels. This category in SESTAT includes individuals working in science and engineering occupations. For further information, see Kannankutty and Wilkinson, note 5.

[9]The term "employed" includes those who worked for pay or profit during the survey reference week. "Unemployed" refers to those who did not have work during that week, but who actively looked for work during the previous four weeks. This population includes those temporarily laid off. "Not in the labor force" includes those who were not designated as either employed or unemployed during the reference week. These definitions were adopted for the NSF SESTAT surveys from Bureau of Labor Statistics definitions. See http://stats.bls.gov/cps/cps_faq.htm.

[10]Unless otherwise noted, all differences stated in this report are significant with a 95-percent confidence interval. Significant tests were performed with a generalized variance function (GVF) model, using parameters available for SDR data sets or for SESTAT data sets for specific years.

[11]Ninety-four percent confidence level.

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Table 1. **Doctoral scientists and engineers by age and labor force status: 1997**

Labor force status	Age (years)									
	Total	34 or younger	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-75
Total	582,080	53,900	76,190	88,120	91,380	91,620	76,120	41,980	32,630	30,140
Employed										
Number	518,440	52,050	73,500	84,960	88,240	88,590	71,520	33,720	17,370	8,500
Percent	89.1	96.6	96.5	96.4	96.6	96.7	94.0	80.3	53.2	28.2
Full time	92.2	95.2	94.0	94.0	94.5	93.8	93.1	88.2	70.3	52.4
Part time	7.8	4.8	6.0	6.0	5.5	6.2	6.9	11.8	29.7	47.6
Unemployed										
Number	6,390	450	860	810	1,240	1,010	930	420	460	220
Percent	1.1	0.8	1.1	0.9	1.4	1.1	1.2	1.0	1.4	0.7
Not in labor force										
Number	57,250	1,400	1,840	2,350	1,900	2,020	3,670	7,840	14,800	21,420
Percent	9.8	2.6	2.4	2.7	2.1	2.2	4.8	18.7	45.4	71.1

NOTES: Numbers are rounded to nearest ten. Details may not add to total because of rounding.

SOURCE: National Science Foundation/Division of Science Resources Statistics, 1997 Survey of Doctorate Recipients

about one-quarter (28 percent) remained employed, about half part time. The percentage that was unemployed (~1 percent) varied little across the entire age spectrum.

For all age intervals, employment rates for scientists and engineers with doctoral degrees were somewhat higher than for scientists and engineers whose highest degree was a bachelor's or master's degree. For example, in the group aged 65-69, 34 and 38 percent of those with bachelor's and master's degrees, respectively, as their highest degree were employed, compared with 53 percent of those with U.S.-earned doctorates.[12]

The distribution of employed doctoral scientists and engineers by principal employment sector (education, government, or industry) showed some variation with age (table 2). The largest differences between age groups for both the industry and education sectors were between scientists and engineers aged 60-64 and 65-69 on one hand, and those aged 70-75 on the other. For those aged 70-75, the percentage working in industry, including the self-employed (49 percent), was considerably greater than in the 60-64 and 65-69 age groups (36 percent for both). In contrast, the percentage of employed doctoral scientists and engineers aged 70-75 working in the education sector (43 percent) was smaller than for those ages 60-64 (54 percent) and 65-69 (56 percent). This result may reflect the tendency of retirees from educational institutions to continue to work in industry or be self-employed as consultants or in some other capacity. However, when the results are differentiated further by full-time versus part-time employment, the picture changes somewhat, as will be discussed below in connection with table 3.

The incidence of part-time work is much higher for those over 59, and particularly for those over 64 (figure 1). Part-time workers constituted about 5 to 7 percent of employed doctoral scientists and engineers aged 59 or younger, about 30 percent of those 65-69 and nearly half (48 percent) of those 70-75. Thus, the part-time doctoral science and engineering labor force has a larger proportion of older workers than the full-time labor force. Those 55 or older constituted 45 percent of part-time science and engineering doctoral employees, compared with only 24 percent of all such full-time workers.

The distribution of part-time doctoral science and engineering workers across the three principal employment sectors (education, government, and industry) was roughly the same for those aged 65-75 as for those 64 or younger (table 3). However, among full-time workers, older doctoral scientists and engineers were more likely to be employed in the education sector and less likely to be employed in industry. For doctoral scientists and engineers aged 65-75 and employed in industry, the ratio

[12]Unlike the SESTAT population (which includes those with a bachelor's or a master's degree as their highest degree), the population sampled for the SDR is restricted to those who earned doctorates from U.S. institutions. However, the differences between SDR results and those derived from the doctoral component of SESTAT are not large enough to affect the comparisons presented in this report.

Table 2. **Employed doctoral scientists and engineers by age, employment sector, and full-/part-time status: 1997**

Employment sector[1]	Age (years)									
	Total	34 and younger	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-75
Total	518,440	52,050	73,500	84,960	88,240	88,590	71,520	33,720	17,370	8,500
Education										
Number	246,830	26,080	34,630	39,850	39,350	40,040	35,320	18,210	9,720	3,640
Percent	47.6	50.1	47.1	46.9	44.6	45.2	49.4	54.0	55.9	42.8
Full time	93.7	94.6	94.3	94.6	95.8	95.9	94.3	91.9	79.8	63.6
Part time	6.3	5.4	5.7	5.4	4.2	4.1	5.7	8.1	20.2	36.4
Government										
Number	53,510	3,860	5,840	8,560	10,780	11,170	7,910	3,380	1,350	670
Percent	10.3	7.4	8.0	10.1	12.2	12.6	11.1	10.0	7.8	7.9
Full time	96.2	98.1	98.2	97.9	97.3	97.4	95.0	96.7	83.0	47.2
Part time	3.8	1.9	1.8	2.1	2.7	2.6	5.0	3.3	17.0	52.8
Industry[2]										
Number	218,090	22,110	33,030	36,550	38,100	37,380	28,300	12,130	6,300	4,190
Percent	42.1	42.5	44.9	43.0	43.2	42.2	39.6	36.0	36.3	49.3
Full time	89.5	95.3	92.9	92.6	92.2	90.5	91.1	80.2	52.9	43.6
Part time	10.5	4.7	7.1	7.4	7.8	9.5	8.9	19.8	47.1	56.4

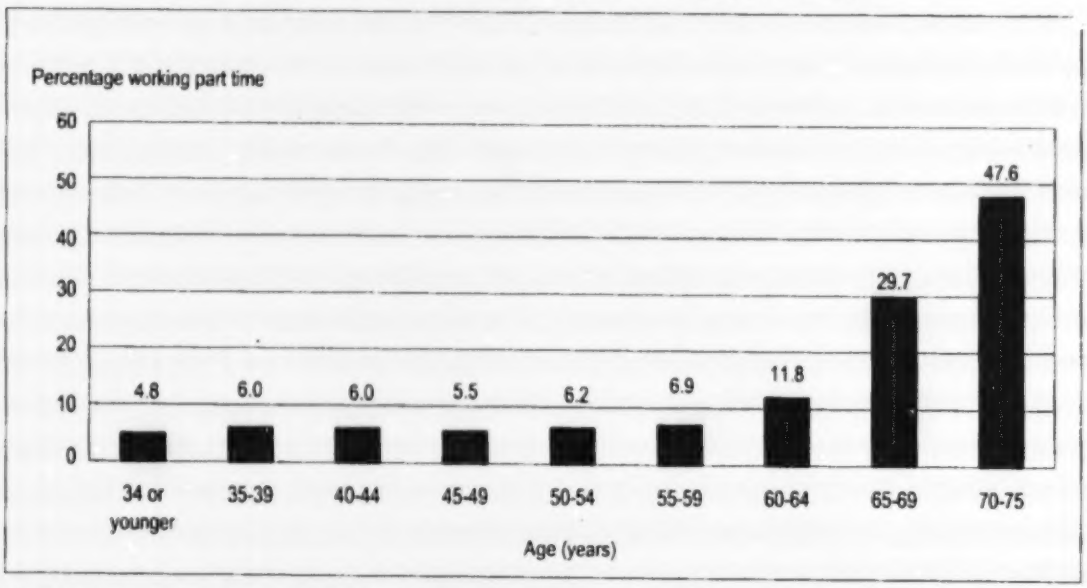
[1]Sector of primary job.

[2]The industry sector contains large and small businesses, as well as self-employed scientists and engineers.

NOTES: Numbers are rounded to nearest ten. Details may not add to total because of rounding.

SOURCE: National Science Foundation/Division of Science Resources Statistics, 1997 Survey of Doctorate Recipients

Figure 1. **Percentage of employed doctoral scientists and engineers working part time: 1997**



SOURCE: National Science Foundation/Division of Science Resources Statistics, 1997 Survey of Doctorate Recipients

Table 3. **Full-/part-time status and employment sector for employed doctoral scientists and engineers 64 and younger and those 65 to 75 years old: 1997**

Full-/part-time status and employment sector[1]	64 and younger		65 to 75 years old	
	Number	Percent	Number	Percent
Total	492,570	100.0	25,870	100.0
Education	233,480	47.4	13,360	51.6
Government	51,490	10.5	2,020	7.8
Industry	207,600	42.1	10,490	40.5
Full-time, total	461,230	100.0	16,670	100.0
Education	221,150	47.9	10,070	60.4
Government	50,030	10.8	1,440	8.6
Industry	190,050	41.2	5,160	31.0
Part-time, total	31,340	100.0	9,200	100.0
Education	12,330	39.3	3,290	35.8
Government	1,460	4.7	580	6.3
Industry	17,550	56.0	5,330	57.9
Education, total	233,480	100.0	13,360	100.0
Full time	221,150	94.7	10,070	75.4
Part time	12,330	5.3	3,290	24.6
Government, total	51,490	100.0	2,020	100.0
Full time	50,030	97.2	1,440	71.3
Part time	1,460	2.8	580	28.7
Industry, total[2]	207,600	100.0	10,490	100.0
Full time	190,050	91.5	5,160	49.2
Part time	17,550	8.5	5,330	50.8
Self-employed, total	21,560	100.0	3,540	100.0
Full time	14,630	67.9	1,530	43.2
Part time	6,930	32.1	2,010	56.8
Percent of total employed that are self-employed	N/A	4.4	N/A	13.7
Full time	N/A	3.0	N/A	5.9
Part time	N/A	1.4	N/A	7.8

[1]Sector of primary job.

[2]The industry sector contains large and small businesses, as well as self-employed scientists and engineers.

KEY: N/A = Not applicable.

NOTES: Numbers are rounded to nearest ten. Details may not add to total because of rounding.

SOURCE: National Science Foundation/Division of Science Resources Statistics, 1997 Survey of Doctorate Recipients

of full-time to part-time workers was about 50:50; in contrast, about three quarters of doctoral scientists and engineers aged 65-75 in education and government were employed full time. In each of the three employment sectors, the percentage working part time was larger for those aged 65-75 than those 64 or younger, a result consistent with figure 1.

Table 3 also illustrates aspects of self-employment as the primary employment for doctoral scientists and engineers. Some 14 percent of those aged 65-75 who were employed were self-employed, compared with 4 percent of those 64 and younger, indicating that self-employment, such as consulting work, constitutes a more significant aspect of employment for older workers. More than half (57 percent) of self-employed doctoral scientists and engineers aged 65-75 worked part time, versus about a third (32 percent) of those 64 and younger.

A previous analysis summarized in *Science and Engineering Indicators: 2000* using 1997 SESTAT data found that those scientists and engineers with doctorates tended to continue to work full time to more advanced ages than their counterparts with bachelor's or master's as their highest degree.[13] By age 63, half of scientists and engineers with bachelor's or master's degrees as their highest degree were no longer working full time whereas for doctoral scientists and engineers, this 50-percent mark was not reached until age 66, three years

[13]Source: National Science Board, *Science and Engineering Indicators: 2000* (Arlington, VA: National Science Foundation, NSB-00-1, 2000), pp. 3-2.

later. By age 70, about 20 percent of doctoral scientists and engineers were still working full time, compared with 10 percent of scientists and engineers with bachelor's or master's degrees as their highest degree.

The distribution of all employed doctoral scientists and engineers by field of doctoral degree was similar for those 64 and younger and for those 65 to 75 years old (table 4). Among those working part time, the distribution by field of degree showed that a larger proportion of those aged 65-75 had doctoral degrees in the physical sciences (26 percent) than did the younger doctoral scientists and engineers (14 percent). In contrast, a smaller proportion of part-time employees aged 65-75 had doctoral degrees in the social sciences (38 percent) than did younger doctorates (48 percent).

Part-time Work

Overall, a greater proportion of doctoral scientists and engineers working part time wanted full-time work than did part-time workers whose highest degree were bachelor's or master's degrees (table 5). For example, for scientists and engineers aged 35-49 working part time, 28 percent of those with doctorates wanted full-time work, compared with 15 percent with master's degrees and 12 percent with bachelor's degrees as their highest degree.

The percentage of doctoral scientists and engineers working part time but wanting full-time work ranged from 24-34 percent for age groups up to 59, dropping steadily thereafter to about 10 percent for those aged 70-75 (table 5). Overall, some 9,650 doctoral scientists and engineers, constituting 24 percent of those employed part time, wanted full-time work. For those aged 60-75, there were 1,670 doctoral scientists and engineers, 13 percent of those working part time, who wanted full-time employment.

Doctoral scientists and engineers aged 65-75 most frequently stated that retirement or semi-retirement was the reason they were working part time (77 percent),[14] followed by not needing or wanting to work full-time

Table 4. Distribution of doctoral scientists and engineers 64 and younger and those 65 to 75 years old by employment status and field of doctoral degree: 1997

Employment status and field of doctorate[1]	64 and younger		65 to 75 years	
	Number	Percent	Number	Percent
Employed, total	492,570	100.0	25,870	100.0
Computer and math sciences	31,270	6.3	1,130	4.4
Life sciences	135,500	27.5	6,280	24.3
Physical sciences	98,910	20.1	6,320	24.4
Social sciences	141,590	28.7	8,700	33.6
Engineering	85,150	17.3	3,430	13.3
Employed part time, total	31,340	100.0	9,200	100.0
Computer and math sciences	1,550	4.9	250	2.7
Life sciences	7,770	24.8	1,850	20.1
Physical sciences	4,400	14.0	2,430	26.4
Social sciences	14,980	47.8	3,470	37.7
Engineering	2,620	8.4	1,190	12.9

[1]A small number of doctoral scientists and engineers with a second doctoral degree in non-science and engineering field are included in the total but not shown separately.

NOTES: Numbers are rounded to nearest ten. Details may not add to total because of rounding.

SOURCE: National Science Foundation/Division of Science Resources Statistics, 1997 Survey of Doctorate Recipients

[14]A related result from a previous study indicates that of the doctoral scientists and engineers aged 63-70 who reported having "retired," some 13.9 and 17.6 percent continued to work part and full time, respectively. For those older than 70, 5.4 percent worked part time and 10.9 percent full time. Source: National Science Board, *Science and Engineering Indicators: 2000* (Arlington, VA: National Science Foundation, NSB-00-1, 2000), pp. 3-23. Note that these results are based on SESTAT, not SDR, data on doctoral scientists and engineers.

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Table 5. **Scientists and engineers working part time, and those wanting full-time work, by level of highest degree and by age: 1997**

Highest degree level[1] and part-time status	Age (years)									
	Total	34 or younger	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-75
Doctorate										
Total working part time	40,540	2,500	4,410	5,060	4,900	5,510	4,950	4,000	5,170	4,040
Want full-time work										
Number	9,650	600	1,100	1,610	1,260	1,880	1,550	650	620	400
Percent	23.8	23.8	24.9	31.8	25.8	34.0	31.3	16.2	11.9	9.8
Master's										
Total working part time	316,570	50,790	37,460	51,760	42,180	36,330	24,380	25,910	26,480	19,280
Want full-time work										
Number	40,160	6,900	3,310	7,700	9,150	5,610	2,270	2,910	1,600	700
Percent	12.7	13.6	8.8	14.9	21.7	15.4	9.3	11.2	5.6	3.6
Bachelor's										
Total working part time	648,540	202,380	79,830	91,760	75,930	52,130	35,810	35,810	39,020	35,880
Want full-time work										
Number	72,530	28,340	8,410	8,200	12,240	6,500	4,380	3,130	1,150	S
Percent	11.2	14.0	10.5	8.9	16.1	12.5	12.2	8.7	3.0	S

[1]Degree level shown designates highest degree obtained as of April 1997.

KEY: S = Suppressed due to too few cases (less than 200 weighted cases).

NOTES: Numbers are rounded to nearest ten. Details may not add to total because of rounding.

SOURCE: National Science Foundation/Division of Science Resources Statistics, 1997 Survey of Doctorate Recipients; 1997 SESTAT data system (for bachelor's and master's).

(33 percent).[15] Some 6 percent said that they could not find a suitable full-time job, indicating that older science and engineering doctoral workers were more likely to be employed part time out of choice rather than necessity.

Buyout Offers

Buyout offers have been received by many doctoral scientists and engineers across the age spectrum at some point in their careers (figure 2).[16] For those 60 or older, the percentage of employed doctoral scientists and engineers receiving buyout offers (28 percent) did not differ greatly from those who were "not employed" (32 percent), that is, either "unemployed" or "not in the labor force." However, some 44 percent of employed scientists and engineers receiving buyout offers accepted them, compared with 89 percent of those who were not employed.

The percentage of doctoral scientists and engineers ever having received a buyout offer was 9 percent or less for groups aged 54 or younger, with most of these offers being rejected. For those aged 55-59, 19 percent had received a buyout offer and 31 percent of those receiving an offer had accepted it. A crossover point—at which half of those receiving an offer accepted it—was reached for the group aged 60-64. About one-third of doctoral scientists and engineers aged 65-69 had received a buyout offer and 72 percent accepted.

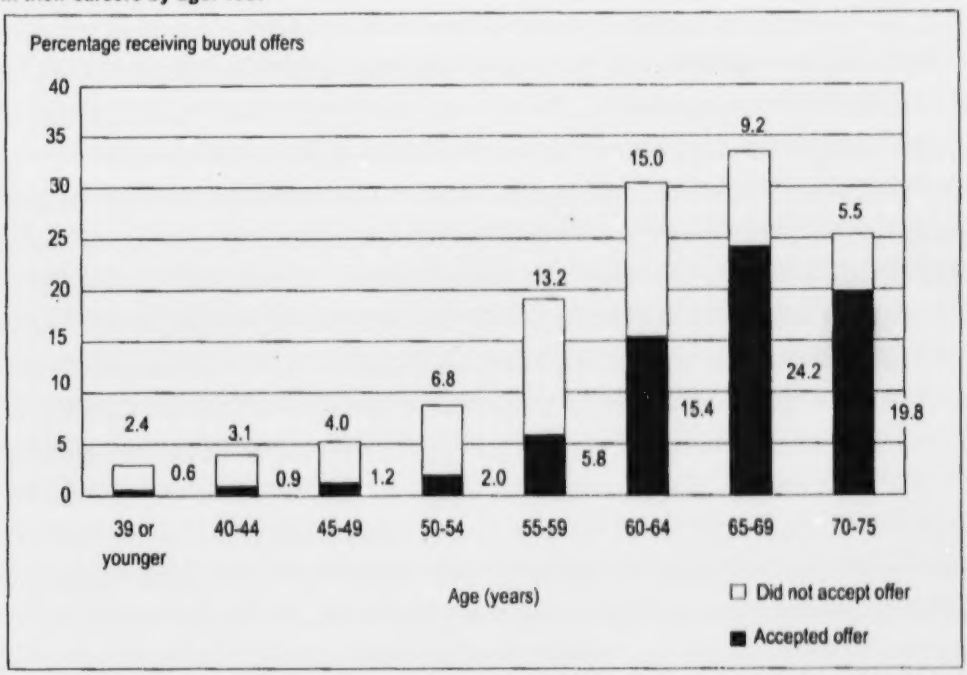
For employed doctoral scientists and engineers 60 or older who ever received a buyout offer, those currently in industry were considerably more likely to have accepted (67 percent) than those in education (36 percent) or government (22 percent) (table 6). It should be kept in mind that reported buyouts may be cumulative and someone who responds within a given age group and employment sector may have received a buyout offer when they were previously in a younger age group and working in different employment sector.

For all (employed and not-employed) scientists and engineers 60 or older, a somewhat higher percentage of

[15]Multiple responses allowed; reports based on 9,210 scientists and engineers aged 65-69.

[16]The survey question was as follows: "Have you ever been offered a buy-out or what is called "early retirement" – that is, a cash settlement to induce employees to voluntarily give up a job?"

Figure 2. **Percentage of doctoral scientists and engineers who received buyout offers in their careers by age: 1997**



SOURCE: National Science Foundation/Division of Science Resources Statistics, 1997 Survey of Doctorate Recipients

Table 6. **Buyout offers to scientists and engineers 60 to 75 years of age by employment status, employment sector, and highest degree level: 1997**

Employment status and sector by highest degree level	Total	Received offer		Accepted offer	
		Number	Percent	Number	Percent
Doctorate					
Employment status					
Total	104,660	31,270	29.9	20,320	65.0
Employed	59,590	16,680	28.0	7,320	43.9
Not employed[1]	45,070	14,590	32.4	13,010	89.2
Employment sector[2]					
Education	31,560	9,000	28.5	3,200	35.6
Government	5,400	2,250	41.7	490	21.8
Industry	22,620	5,430	24.0	3,630	66.9
Highest degree level[3]					
Doctorate	104,660	31,270	29.9	20,330	65.0
Master's	496,090	117,440	23.7	90,980	77.5
Bachelor's	965,890	222,570	23.0	178,470	80.2

[1]"Not employed" includes unemployed plus those not in the labor force.

[2]Sector of current primary job.

[3]Degree level shown designates highest degree obtained as of April 1997.

NOTES: Numbers are rounded to nearest ten. Details may not add to total because of rounding.

SOURCE: National Science Foundation/Division of Science Resources Statistics, 1997 Survey of Doctorate Recipients; 1997 SESTAT data system (for bachelor's and master's).

those with doctoral degrees (30 percent) had received a buyout offer sometime during their careers than those whose highest degree were bachelor's (23 percent) or master's (24 percent) degrees. However, the percentage of those in this age group receiving buyout offers that actually accepted the offers was lower for scientists and engineers with doctorates (65 percent) than it was for those whose highest degree was a master's (78 percent) or bachelor's (80 percent) degree.

Health Insurance Benefits

Health insurance benefits may be related to scientists' and engineers' employment decisions. Health insurance costs are on the rise and may constitute a major expense for older or retired workers. Over 90 percent of employed doctoral scientists and engineers aged 64 or younger had health insurance benefits made available to them that were at least partially paid for by their employers (table 7).[17] Older doctoral scientists and engineers had substantially lower proportions with health insurance benefits made available to them: 79 percent for those aged 65-69, and 58 percent for those aged 70-75. These smaller percentages may be attributable to older scientists and engineers being more likely to receive Medicare benefits, to work part time or be self-employed, to have benefits from a previous position, or to have spouses with benefits covering both.

Across employment sectors, older doctoral scientists and engineers working in industry (which includes the self-employed) were less likely to have health benefits

Table 7. Scientists and engineers whose employers made available at least partially paid health benefits by age, highest degree level, and employment sector: 1997

Highest degree level/health benefits	Age (years)									
	Total	34 or younger	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-75
Highest degree level[1]										
Doctorate, total	493,080	51,430	71,810	81,430	83,550	83,260	67,720	31,560	15,310	7,000
Number with health benefits	457,020	48,210	67,800	77,200	78,360	77,510	63,190	28,610	12,090	4,040
Percent	92.7	93.7	94.4	94.8	93.8	93.1	93.3	90.6	79.0	57.7
Master's, total	2,812,050	470,490	396,210	457,430	525,090	473,570	265,800	132,890	57,370	33,200
Number with health benefits	2,366,190	415,940	349,860	390,130	450,990	408,840	217,020	94,650	28,600	10,170
Percent	84.1	88.4	88.3	85.3	85.9	86.3	81.6	71.2	49.9	30.6
Bachelor's, total	6,151,470	2,037,290	903,790	965,570	913,830	633,110	340,100	195,270	95,980	66,520
Number with health benefits	5,039,940	1,721,930	778,810	805,570	754,560	518,330	261,490	131,170	46,530	21,550
Percent	81.9	84.5	86.2	83.4	82.6	81.9	76.9	67.2	48.5	32.4
Doctorate scientists and engineers with health benefits by employment sector[2]										
Education										
Number	235,110	24,390	32,970	38,530	37,880	38,840	34,010	17,300	8,520	2,670
Percent	95.3	93.5	95.2	96.8	96.5	97.0	96.6	95.0	87.8	73.3
Government										
Number	51,060	3,750	5,490	8,300	10,450	10,670	7,650	3,250	1,140	370
Percent	95.4	97.1	94.0	97.0	96.9	95.6	96.8	96.2	84.0	55.2
Industry[3]										
Number	170,860	20,080	29,330	30,380	30,040	28,010	21,530	8,060	2,440	1,000
Percent	88.5	93.4	93.6	91.8	89.7	87.4	87.5	80.8	57.3	37.1

[1]Degree level shown designates highest degree obtained as of April 1997.

[2]Sector of primary job.

[3]The industry sector contains large and small business, as well as self-employed scientists and engineers.

NOTES: Numbers are rounded to nearest ten. Details may not add to total because of rounding.

SOURCE: National Science Foundation/Division of Science Resources Statistics, 1997 Survey of Doctorate Recipients (for doctorates); 1997 SESTAT data system (for bachelor's and master's).

[17]The survey question was as follows: "Concerning your principal job during the week of April 15, were any of the following benefits available to you, even if you chose not to take them?" One of four multiple response (Yes-No) items was: "Health insurance that was at least partially paid for by your employer."

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partially funded by their employer than those in education or government. For those 65 or older, half (50 percent) working in the industry had employer-provided health benefits available to them, compared with three-quarters (75 percent) in government and 84 percent in education. This latter result also may reflect the higher tendency of older doctoral scientists and engineers employed in education and government to be in full-time employment.

For all age groups, doctoral scientists and engineers were more likely to have access to health benefits at least partially paid for by their employers than their counter-parts with their highest degree at the bachelor's or master's level (table 7). For those 65 or older, the availability of benefits was reported by 72 percent of doctoral scientists and engineers compared with 42 and 43 percent of those with bachelor's or master's degrees, respectively, as their highest degree.

Job Satisfaction

The degree of job satisfaction may also be related to scientists and engineers' employment status. In 1997, greater percentages of employed doctoral scientists and engineers in older age groups expressed satisfaction with their jobs than those in younger age groups. For example, while 71 percent of those 65 or older were "very satisfied" with their jobs, this level of satisfaction was reported by 50 percent of those 54 or younger. This distinction was less pronounced if those at least "somewhat satisfied" are also considered. There were 89 percent of scientists and engineers aged 49 or younger very or somewhat satisfied with their jobs, compared with 96 percent of those 65 or older.

Publications and Patents

Two indicators readily derivable from 1995 SDR data may be used to illuminate the relationship between the productivity of doctoral scientists and engineers and their age. The 1995 SDR collected information on two research outputs that may be used as a proxy to measure the productivity of doctoral scientists and engineers, namely publications and patents. The indicators examined in this report are the article publication rate and the patent activity rate.

The article publication rate (APR) is defined as the percentage of doctoral scientists and engineers in a given age group who authored or co-authored at least one paper accepted for publication in a refereed journal between April 1990 and April 1995. For employed doctoral scientists and engineers, the APR had progressively lower values for older age groups (table 8). For example, the APR of doctoral scientists and engineers aged 60-75 was only 40 percent as large as the value for the group aged 35-44. If only those employed doctoral scientists and engineers who were in the education sector are considered, the fall-off was more gradual: the APR for those aged 60-75 was 70 percent of that for the group aged 35-44.

Previous analysis has indicated that doctoral scientists and engineers in the education sector who published less frequently than their peers were more likely to leave full-time employment.[18] For doctoral scientists and engineers aged 51-65, those who did not publish at all left full-time academic employment at four-year institutions between 1995 and 1997 at a rate more than twice that for those publishing six or more articles.

Table 8. **Article publication and patent activity rates for employed doctoral scientists and engineers by age: 1995**

Indicator	Age (years)									
	Total	34 or younger	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-75
Article publication rate[1]	56.2	81.3	74.7	65.7	56.9	51.2	48.4	40.3	26.6	12.8
Patent activity rate[2]	12.4	13.9	15.7	14.5	12.3	10.5	10.2	7.4	9.8	9.0

[1]The percentage of employed doctoral scientists and engineers who (co)authored at least one paper accepted for publication in a refereed journal during the five-year period from April 1990 to April 1995.

[2]The percentage of employed doctoral scientists and engineers who were named as inventors on at least one patent application during the five-year period from April 1990 to April 1995.

SOURCE: National Science Foundation/Division of Science Resources Statistics, 1995 Survey of Doctorate Recipients

[18]Source: National Science Board, *Science and Engineering Indicators: 2000* (Arlington, VA: National Science Foundation, NSB-00-1, 2000), pp. 3-24.

The patent activity rate (PAR) is defined as the percentage of doctoral scientists and engineers in a given age group named as an inventor on at least one U.S. patent application from April 1990 to April 1995.[19] For employed doctoral scientists and engineers, the PAR also had lower values for older age groups but the decline in values was somewhat more gradual than for the article publication rate. For doctoral scientists and engineers aged 60-75, the PAR was about half (47 percent) that of the group aged 35-44 and about two-thirds (67 percent) of that for the group aged 45-59.

If only employed doctoral scientists and engineers in the education sector are considered, the patent activity rate for those aged 65-75 was about the same as for all doctoral scientists and engineers in education (7 percent versus 6 percent, respectively). In contrast, the article publication rate for those aged 65-75 (61 percent) was smaller than for all age groups combined (78 percent). Thus, there is some indication that, unlike publications, patent output within academe may not decline with age.[20]

Summary and Conclusions

This report has presented information on educational and work-related activities, and characteristics of doctoral scientists and engineers as a function of age using data from the 1997 Survey of Doctorate Recipients (SDR). During the mid-1990s, there was a continued trend towards aging of this population. Furthermore, higher percentages of older doctoral scientists and engineers continued working than scientists and engineers whose highest degree were bachelor's or master's degrees. In 1997, about half of those 65 to 69 and about a quarter of those 70-75 with doctorates were still working. Those with bachelor's or master's degrees as their highest degree who were not employed were less likely to be looking for work than those with doctorates.

Employed doctoral scientists and engineers in industry at 60 years of age and older were much more likely to state that they had accepted a buyout offer sometime in the past than those working in government or education. However, doctoral scientists and engineers 60 years of age and older were less likely to accept a buyout offer they had received than those with bachelor's or master's as their highest degree.

Older doctoral scientists and engineers in industry were less likely to have had health benefits available to them than their counterparts in education or government. Higher percentages of doctoral scientists and engineers had access to health benefits than scientists and engineers whose highest degree were bachelor's or master's degrees. About 70 percent of doctoral scientists and engineers aged 65 and older were very satisfied with their jobs, compared to 50 percent of those aged 54 or younger.

Two indicators derived from 1995 SDR data, the article publication rate and the patent activity rate, provide limited information on the relationship between the productivity of doctoral scientists and engineers and their age. Doctoral scientists and engineers in their 60's and 70's were much less likely to have authored or co-authored at least one published paper within a five-year period than their counterparts in their 40's. The gap is smaller in the education sector than in government or industry. In contrast, the patent activity rate, an indicator based on patent applications, was only about a third greater for doctoral scientists and engineers in their 40's than those on their 60's and 70's. Furthermore, the patent activity rate for doctoral scientists and engineers in the education sector is about the same for those aged 65-75 as for all ages combined.

This report represents a first cut at analyzing some of the results of the 1997 SDR concerning labor force characteristics and age. Further analysis could examine the results using other characteristics such as occupation, gender, citizenship and race/ethnicity.

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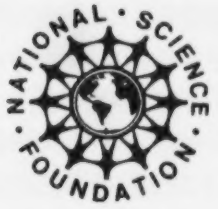
[19] Additional information in the 1995 SDR is available on numbers of patents granted as well as numbers commercialized. However, these variables, which require more elaborate analysis, were not examined for this report. Further information on how the number of patents granted and the number commercialized may be utilized as productivity indicators can be found in R. P. Morgan, C. Kruytbosch and N. Kannankutty, "Patenting and Invention Activity of U.S. Scientists and Engineers in the Academic Sector: Comparisons with Industry," *Journal of Technology Transfer* 26 (2001): pp. 173-83.

[20] For more detailed analysis, using SESTAT data, of the patenting and invention activity of U.S. scientists and engineers, see R.P. Morgan, C. Kruytbosch and N. Kannankutty, note 19.



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Older Doctoral Scientists and Engineers: Selected Labor Force Characteristics

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